# Work-Based Learning in the Mexican Automotive Sector

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**Abstract.** A stronger work orientation or even the integration of learning into activities will be one of the central basic requirements for the success of Industry 4.0. Using the example of the project E-Mas (Exporting blended vocational education and training for industrial process design and optimization into the Mexican automotive sector), the paper discusses the development and implementation of a highly work oriented further education program. Together the partners Research Institute for Industrial Management at RWTH Aachen University e.V. [FIR], MTM ASSOCIATION e.V. [MTMA], WBA Aachener Werkzeugbau Akademie GmbH [WBA] in cooperation with the Mexican Instituto Tecnológico y de Estudios Superiores de Monterrey [ITESM] pursue the goal of designing and exporting innovative further education programs for skilled workers, developers, and operative management personnel of the Mexican automotive sector and especially German companies operating in Mexico.

**Keywords:** Further education · Automotive sector · Work orientation · New work · Internationalization · Blended learning

## 1 Introduction

Under the leadership of the Research Institute for Industrial Management at RWTH Aachen University e.V. [FIR], the MTM ASSOCIATION e.V. [MTMA], the WBA Aachener Werkzeugbau Akademie GmbH [WBA] in cooperation with the Mexican Instituto Tecnológico y de Estudios Superiores de Monterrey [ITESM] have joined for the development of the E-Mas further education program (BMBF, 2017–2021). Together the partners pursue the goal of designing and exporting innovative further education programs for skilled workers, developers, and operative management personnel of the Mexican automotive sector and especially German companies operating in Mexico. For this purpose, a comprehensive, coherent, and certified teaching and learning offer about tactical and operative production management for employees of the Mexican automotive sector was developed and implemented. The training program explicitly considers the current transformation of the companies to Industry 4.0 and thus proactively prevents competence deficits.

The offers focus on the integration and close interlocking of work and learning processes. In this direction, training and education content was further developed and combined into an innovative work-related blended learning-based further education program,


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translated, and offered on-site. Key competencies in the areas of productivity management, work-related learning, toolmaking, and Lean Management are taught to empower employees in the automotive sector in Mexico for the transformation to Industry 4.0 and to promote further industry growth. The training courses are offered in both, the form of a comprehensive overall program and in individual offerings that can also be a supplement to existing teaching content on the customer side. The project acronym E-Mas stands for Exporting blended vocational education and training for industrial process design and optimization into the Mexican automotive sector. It is a variation of the Spanish term '*y más*' [English 'and more'] and expresses the progress and gain in Mexican vehicle and supplier part production through the developed international training program. The transfer and adaptation of the partners' training program are intended to eliminate existing competence deficits given the increased demand for qualified specialist personnel.

The training program developed by the project partners to improve the skills of employees in the Mexican automotive sector consists of four modules:

1) The teaching of new technology-supported and classic concepts of work-related learning in Industry 4.0
2) Competence development in the field of productivity management and industrial engineering
3) Further training in the field of repair and new production of tools for OEMs and suppliers
4) Advanced training in Lean Management methods for Industry 4.0

The subject areas were combined in an overall offer and worked out in extensive modules. Customers will later be able to use the offers of all four requirement areas, or modules in combination, or to decide on case-specific offer packages. A joint marketing concept of the consortium partners was developed and implemented for the distribution of the overall offer. To ensure a flexible offer in terms of time and to quickly achieve economic viability, the training offer was realized as a blended learning concept. Classroom training, an e-learning platform, inverted classroom concepts, webinars [live broadcasts, partly from the Demonstrationsfabrik Aachen, DFA], recorded video seminars and online testing facilities were established. In the DFA, located at the FIR, pre-series vehicles for electric vehicles are manufactured, therefore it is an ideal venue for training in the automotive sector.

The fourth industrial revolution was chosen as the main topic to counteract the shortage of skilled workers in middle management and to enable workers to successfully take over corresponding tasks and activities that fall within this middle management level. The concept focuses on the transformation of companies to Industry 4.0, which could be described as a 'course on tactical and operational production management for the automotive sector in Mexico on the way to Industry 4.0'. In general, production management comprises all activities of planning, ordering, and controlling production in a company. Three different types or levels can be distinguished:

1) Strategic production management: cases of fundamental decisions
2) Tactical production management: implementation of decisions and

3) introduction
4) Operative production management: execution of the daily production management

While strategic tasks are usually performed by academically qualified personnel at management level, tactical and operational tasks are located at an intermediate level of qualification, precisely at the level that the Mexican industry is currently experiencing a high shortage of skilled workers. The aim is to cover the overriding objectives of production management through the E-Mas overall offering and to provide appropriate teaching and learning content. The following four can be identified as these overriding goals:

1) Productivity
2) Employee health
3) The versatility of technical systems
4) Continuous process innovation

The latter two objectives 3 and 4 reflect above all, the requirements for Cyber-Physical Production Systems [CPPS], which represent a paradigm in digital production and are therefore of particular interest for the development towards Industry 4.0. The four partners cooperating in E-Mas can ensure complete coverage of these goals by combining their offers, which is the motivation for this selected consortium to work together in the E-Mas project. The goals are covered by the individual thematic modules of the consortium partners, those modules are dedicated to the fields of, Learning and Working in Industry 4.0 [FIR], Productivity Management and Industrial Engineering [MTMA], Toolmaking Management [WBA] and Lean Management Methods for Industry 4.0 [WBA] (see Sect. 5 for a more detailed description). The offered modules' content is divided into a 5-day course, during which the topic is taught using the multiple resources of the blended learning concept. Considering research being done by the partners of the program, industry cases of challenges, team interaction activities, practical applications with specialized software, and also providing spaces for networking between participants, this serves as a platform to share experiences and solutions to previous challenging situations with a successful outcome. This initial offer can be adapted to the special requirements of the companies, providing a customized solution for each specific case. This is possible due to the flexibility that characterizes the modules and the agility upon which the construction of the entire content offer is based. Figure 1 shows the general consortium structure of the E-Mas Program.

To better introduce this work-related training program, it is not only important to understand the relationship between the Mexican and German economies and their cooperation activities, but also to grasp information about the crucial share that the automotive industry carries in the overall production activities in these markets. Under this context, the content of the courses is developed describing the challenges that the evolution of technology raises and proposing potential solutions that organizations could apply to overcome such challenges. Using cooperation and support projects, companies could enable the development of the appropriate skills in their middle managers for the smooth transformation of their specialized area of work. Chapter two deals with a short explanation of the Customer-Focused Blended Vocational Education and Training Development


**Fig. 1.** E-Mas program consortium structure [own illustration]

Navigator [CBVET], a tool for the implementation of educational services ideas into the market, under which the E-Mas program is developed. In the third chapter, the E-Mas course principles, its learning taxonomy, and how it is combined with a blended learning approach are clarified, providing insightful information on the general thought structure behind the courses. Furthermore, the content of each course and how it is distributed through the materials of the blended learning concept is analyzed. This serves as the basis for enabling the description of the degree of work orientation for the E-Mas further development training, which is described in the fifth chapter. In the following chapter, the five dimensions and their criteria of evaluation to achieve a high work orientation of the training courses are defined.

### 1.1 Mexican – German Cooperation Model

In recent years, the cooperation between Germany and Mexico has intensified from an economic perspective as well as from an educational perspective. For instance, Mexico was the first non-European Partner Country at the 2018 Hannover Fair in Germany, one of the biggest industrial technology fairs worldwide. According to the Mexican Ministry of Economy, there are over 1,900 German companies established in Mexico. As these companies are investing a considerably high amount of resources in Mexico, Germany

has become the fourth source of foreign direct investment into the country. Thus, leading German companies aim to influence the way other companies operate in the Mexican industry.

Germany has been active in Mexico with some socio-cultural offers in the field of basic education promotion, in which both countries have been working together successfully since the 1970s. Beginning in 1997, the German Society for International Cooperation [GIZ] has been advising the Mexican government on behalf of the German Federal Government (Gesellschaft für Internatinale Zusammenarbeit [GIZ], n.d.). The Mexican government has shown interest in establishing a vocational training system based on the German model in the last years (Dummer 2014). Besides, there are cooperation agreements that are to implement the German-style dual training system, which does not exist in Mexico so far. The German Federal Institute for Vocational Education and Training [BIBB] is working with its partner institute at the Mexican National College of Technical Professional Education [CONALEP] to transfer elements of Germany's dual training system to Mexico (Steinmeyer et al. 2012, p. 29). This is being done within the framework of the project Further development of the Mexican model of dual vocational training [MMFD], a cooperation project of the Federal Ministry for Economic Cooperation and Development [BMZ], the Federal Ministry of Education and Research [BMBF] and the Secretary of Public Education [SEP] in Mexico (Bundesinstitut für Berufsbildung [BIBB] 2017). The project's overarching objective is to introduce dual elements into the Mexican vocational training system, for which the BIBB primarily conducts various advisory activities.

### 1.2 The Mexican Automotive Sector and Further Education

The automotive sector remains one of the most challenging industries around the world. Consumer requirements are changing rapidly, product lifecycles are getting shorter, OEMs keep increasing their quality and flexibility requests, automation is growing among the part production industry, expansion and internationalization of the product value chain increase, and the use of electric autonomous vehicles is becoming part of a new reality. Mexican automotive companies are appealing to the technologies of Industry 4.0 to meet the market's requirements, and believe that these innovative solutions are the key to improving their productivity and enhancing their production (Mexico Business Publications 2018). However, to transform into a digital factory, business leaders must start by developing a digital strategy that targets organizational aspects [structure, culture, competences], establish the human asset as its main foundation, and settle its leadership as a transformational agent. The growth of the Mexican automotive industry is strongly driven by German companies, which are increasing their international production capacities by expanding existing locations and building new plants (Volk 2016).

In these times of change and when the new normal is conceived under the term VUCA [volatile, uncertain, complex, and ambiguous], organizations are continually experiencing the permanent challenges of the digital era. Political instability, changing needs, intense competition, and the increased control and power of consumers are some of the factors that have urged the automotive supply chain to meet the Industry 4.0 requirements. Most of the companies have been allocating their resources to the development,

acquisition, and implementation of new technologies in their production. Nonetheless, they have neglected that one of the most critical challenges is the strengthening and adaptation of current leadership functions and competences. In addition to the technological and organizational modifications, the leadership development approach and the traits, skills, and behaviors that the human talent has, must be adjusted to prepare future leaders for the previously mentioned challenges. In 2015, 1,660 companies operated in the Mexican automotive industry. According to the article 'Crafting the future: A Roadmap for Industry 4.0 in Mexico', 62% of the market players belong to the Small and Medium-sized Enterprises business group (Inegi-Amia 2018). In 2017, the automotive industry produced 20.2% of the Mexican Manufacturing GDP and employed over 824,000 workers, representing more than 1.5% of the economically active population (Inegi-Amia 2018).

In this regard, the Mexican automotive industry, as one of the production leaders in the Western Hemisphere, is expected to grow even more due to the ratification and implementation of the USMCA [United States-Mexico-Canada Agreement].This requires an increase of North-American produced automotive product content from 62.5% to 75% by the year of 2023, and also establishes that 40% of automobile parts are required to be produced in an area where the average labor wage is at least 16 USD/hr., providing the legitimation for Mexican automotive industry to implement better automated processes.

Training and further education in Germany and Mexico, especially in the automotive market, are characterized by differences as well as parallels. Although both countries have compulsory schooling, the general drop-out rate in Mexico is very high despite this (König 2013; Steinmeyer et al. 2012, p. 29). Compared to Germany, Mexican education is generally considered to be overburdened by the requirements of Industry 4.0 and the quantity of students, which, together with the high drop-out rate, implies that the basic skills of many employees cannot be compared with the training standard in Germany. The dual training system, which is considered the figurehead of the German education system, is still being established in Mexico and is thus in its infancy (Bundesinstitut für Berufsbildung [BIBB] 2014). In 2016, about 250,000 pupils were already learning at vocational schools, but without any connection to a training company. The target by 2018 was that a total of 5,000 pupils in Mexico were to be taught in a dual vocational training system (Kramer 2016). Efforts in this area are numerous. However, even the projects implemented to date and those planned to increase the number of skilled workers undergoing dual training are not sufficient to fully cover the current and future demand for skilled workers. As a result, more continuing training measures are needed in addition to initial training. In this way, for instance, unskilled workers can be qualified according to demand and already trained specialists from other areas can be retrained for the automotive sector.

### 1.3 Demands for the Company Transformation

Digital transformation in all aspects of our life has become the right model when it comes to developing our future environment. As we go digital, we can recognize a series of changes in the production industry that lead us to face new challenges for the development of society, for instance, changing paradigms at the conception and implementation of new ideas. The way consumers perceive products and their core production process

is expected to influence their consumption behavior and thus, in turn, influence production methods. Companies with a clear purpose and sustainability mindset increase their chances to thrive positively in the market. But when it comes to production methods, companies are looking forward to being recognized with adjectives such as lean, efficient, low cost, green, high tech and/or innovative. A side effect of the digital transformation is the false argument and belief that jobs for people will be negatively affected. We have already experienced the first, second, and third technological revolutions and these experiences tell us that the transformation only positively changes people's skills requirements. Within the scope of a study, for which200 companies were surveyed, 56% of those expect the number of people in the workforce to stay constant or even increase. Nonetheless, demographic challenges could present special cases, such as in the case of Germany, where the workforce is expected to decrease by 3.5 million fewer trained employees by 2030 compared to today. In this case, it is very likely that digitalization can help to decrease that necessity up to 2 million.

For the digitalization of the industry, a new mindset is required; companies are changing the recruitment processes and the benefits as well to fit new profile demands. New qualifications are already described in job advertisements, and to take the most of what the digital environment has to offer, different strategies are implemented or expected to be implemented in the organizations. Companies expect that highly trained, skilled employees start to grow among their workforce over the next 5 years. In the higher education range, the growth is expected to increase by 5 percentage points, rising from 19% to 24% of the total workforce Vocational training is expected to maintain 59% of the required employment base, and unskilled workers are expected to decrease from 21% to 17% of the total workforce. For instance, the amount of people trained in the areas of data analytics or software programmers is expected to increase, while, on the other hand, the number of line workers required in new production lines will tend to decrease (Geissbauer et al. 2017, pp. 31–38).

A survey was carried out by the Institute of Industrial Management at the RWTH University, to obtain valuable data that supports the development of a leadership framework that satisfies the needs of the Industry 4.0 in the Mexican automotive industry. The survey contained a series of questions that targeted the analysis of People, Technology, and Organization. The results showed that 'Talent development', 'Change-oriented vision', and 'the ability to inspire and motivate collaborators' were ranked number 1, 2, and 3 respectively; respondents also believed that today's and future leaders must have 'Change management', 'Adaptability', and 'Result-oriented vision' within their skillsets (Paez Garza 2020, p. 64).

The concept of leadership development is considered key within a set of skills that define the personality of actors who guide an organization. Moreover, it is critical to note that this skillset evolves along with the emergence of new technology and knowledge. Today, many business leaders are overwhelmed with a wide array of innovative technologies that are saturating the automotive market. As mentioned in the book 'The Technology Fallacy', there is a mismatch between the rate of technological change and the responsiveness that people, organizations, and public institutions have towards it (Kane et al. 2019, p. 29). Leaders are required to develop a business strategy that provides their

companies, including all stakeholders, with the capabilities to efficiently embrace the technological, organizational, and social changes that the Industry 4.0 generates.

### 1.4 Changes in the Corporate Culture

The previously mentioned low availability of professionals capable of performing in digital factories has generated a latent conflict between organizations; this challenge is the result of the other disruptive trends in this branch. Business leaders must strengthen their current human capital development strategy so that they mainly rely on the actual workforce, instead of replacing current employees with external talent. To achieve digital transformation, the adaptation of the corporate culture is one of the first tasks on the 'to-do' list. The organizational performance of a company can be improved when its culture is aligned with the business strategy, its organizational structure, its human capital, and the market requirements. To develop a culture that meets the needs of the digital era, specifically in the automotive industry, leaders must start by determining, which is the current state of their corporate culture, followed by evaluating the industry where the organization operates, considering the maturity of the market, customer requirements, as well as challenges and disruptive trends. To process the evaluation of the actual situation, dimensions or variables must be selected to determine the desired corporate culture. By doing this, executives can locate their organization in a two-dimensional plane that will facilitate the process of identifying the behaviors and core values that their workforce needs to meet with the value proposition of the organization. The alignment of the new corporate culture with the organizational structure and business strategy is the fourth step of the reconfiguration process. High-level leaders are responsible for matching the desired culture with the company's mission, vision, and organizational objectives. By doing this, confusion can be avoided, and cross-functional departments will be able to collaborate in the same direction. The final step is the implementation of strategic measures that allow the distribution of the updated corporate culture; the application of change management methodologies is potentially beneficial.

### 1.5 Development of Skills in the Workforce

Granting decision-making power, giving regular-basis feedback, and planning career and development paths, are simple but effective exercises that could strengthen the development of talent. Instead of focusing on building the company, managerial staff must practice empowerment and become people-oriented. The upper management cannot grow a company on their own; they need to transform employees into competent leaders, which will then help the company to flourish. The digital transformation requires employees with the mental preparation of driving and implementing change effectively. Strictly related to innovation, head officers must be change-oriented with an adaptable, agile, and malleable mindset that provides them with the ability to detect threats and reconfigure business strategies to maintain competitiveness. Managing change is a 'must' in the leadership 4.0 skillset; promoting change isn't enough, the staff can detect problems and opportunity areas, run diagnostic tools, and implement changes through development, implementation, and improvements.

Motivating others plays a key role in the digital transformation. Encouraging employees to set challenging goals, supplying them with the necessary tools and knowledge to operate efficiently, and leading through others will improve the overall organization's performance. Leaders who empower, ask questions, and delegate authority instead of tasks, will not acquire followers, they will develop more leaders, which provokes organizational sustainability (Craig Groeschel 2018, p. 1). Roy et al. described relationship building as another main skill needed for effective virtual leadership, to build cooperation and trust, there must be a well-defined leader-follower relationship between the work team members. Building a strong and solid relationship can help to solve issues faster and ensure the sharing of information and knowledge between peers. One main component is trust, where all actions count regarding creating an environment of trust at work. Also, delegating activities, honest and non-critical communication, and last but not least, trust is built by fulfilling commitments made to the team (Roy 2012, p. 57). Today product development and production are done through the cooperation between multidisciplinary team members, involved in different stages to solve issues that arise during the life cycle of goods. Therefore, one important skill required by global companies today is the ability to work in teams.

As verbal communication through virtual media becomes of higher relevance, being able to communicate effectively in the work environment is crucial to establish goals at every level of the organization. From the C-Suite to the shop floor operative staff members, transmitting clear objectives avoids waste of time and resources in all processes. In the study of leadership ability to communicate with others, certain personality traits of emerging leaders were given a relatively more important role, which often include sociability, extraversion, nurturance, or assertiveness. These traits are often evaluated directly through the implementation of assessment centers, in which other capacities, such as non-verbal communication, are overlooked. However, this could have its root in the fact that measuring the quality of the message could be a challenging task. As Riggio et al. exposed in 2003, if measuring the impact of a message were easier, it would not be surprising that saying the right words at the right moment would be more important than being extroverted. (Riggio et al. 2003, pp. 83–84). In oral communication, encoding and decoding messages clearly is a critical characteristic for the leader's effectiveness. This is crucial to developing good interpersonal relationships with team members and peers. Encoding provides the correct words by the leader to clearly explain what is required and expected and leaving no doubt in the listeners. Decoding a message includes, apart from listening, also awareness of the time and environment in which the person communicating experiences the events of the message. Another particular characteristic involved in the effective communication is the role-playing of leaders, which is related to self-monitoring. In such situations, leaders analyze their environment and the peers who are sharing the environment to adapt their behavior according to the situation that involves them. (Riggio et al. 2003, p. 85).

Today the digital presence of organizations has become a backbone to attract new customers, improve its public relationships, and even attract new talent to the company. Nonetheless, not all users have developed the same skills and logic to deal with this new approach. Hence, companies must be aware of what skills are necessary to be developed among their employees towards a digital fluency. Initially, Miller and Barlett started

with the already described concept of Information Literacy [IL] to describe the ability of knowing, identifying, finding, evaluating, organizing and using existing information to create new knowledge. They also suggested that this term is used as the basis to create the term digital literacy, which is the ability to make an informed judgment about what is found online but making an emphasis on the fact that abilities to reach literacy are independent of digital technology. Therefore, Miller and Barlett suggest that digital fluency includes the abilities that are involved in and related to digital literacy, but have their roots in digital technology. (Miller and Bartlett 2012, pp. 36–38).

Industry 4.0 has forced the organizations to rethink the way they are developing their human talent. Still, many companies rely on traditional classroom-based programs that, for today's changing world, are not adequate. The E-Mas program, with its blended structure, is part of the Vertical and Systemic model that counteracts the deficiencies that traditional horizontal programs have. Some of the benefits that individuals experience by participating in a blended learning course are:

- Participants can immediately apply their acquired knowledge to their own company
- The lessons can be transferred to real-life scenarios, which allows the identification of bottlenecks and problems in processes
- Enables collaboration between participants, both in person and through digital platforms
- Blended-learning programs are self-organizing: the participants can check their progress at any time

  – These programs are responsive, flexible, and tailored.

## 2 E-Mas Learning Taxonomy and Blended-Learning Concept

The blended learning concept of E-Mas, i. e. the division of training content into classroom- and e-learning content, is based on a comprehensive learning taxonomy that was used for each learning unit and allows a division according to didactic and pedagogical aspects. In general, a so-called inverted-classroom concept was pursued. This means that factual knowledge and basic conceptual knowledge are first conveyed using e-learning before more in-depth conceptual and procedural knowledge is taught in the form of face-to-face sessions. This was followed by training tasks, both in the form of e-learning units and live broadcasts. Furthermore, digital examination formats were tested and implemented, and digital success control was carried out regarding the concrete application of the learned content and the implementation of the participants' learning objectives. The overall pedagogical and didactic design paradigm of the planned inverted-classroom concept was adapted to the technical, cultural, and economic conditions and, above all, to the requirements of the respective customer. In the following, the E-Mas concept for defining e-learning content is described in detail.

The concept of so-called blended learning refers to teaching and learning arrangements that combine e-learning and face-to-face learning (de Witt & Czerwionka). A further distinction is made between face-to-face learning with the accompanying use of digital media, (de Witt & Czerwionka) synchronous [e.g. webinar, social media],

and asynchronous e-learning (de Witt & Czerwionka; e-teaching.org). In addition to the advantages of blended learning [e.g. more self-determined learning, application orientation and flexible design of teaching-learning scenarios, reduction of financial expenditure, better availability of learning materials] in teaching and learning arrangements (Acatech 2016; Gundermann 2015; Bundesministerium für Arbeit und Soziales [BMAS] 2016b; e-teaching.org 2017), the use of media has the additional benefit of promoting media competence [digital literacy] working world that is becoming more digitalized (Bundesministerium für Arbeit und Soziales [BMAS] 2016a; CEDEFOP 2015).

In principle, E-Mas is based on the concept of learning solutions (Gundermann 2015; Eichler et al. 2013; Kerres 2012; Seufert and Schuchmann 2013). These are understood as innovative learning solutions that draw on current pedagogical, psychological [including cultural aspects], didactic, methodological, and technological findings. This includes the user-oriented combination of new technologies, learning formats and processes, learning environments, and business models, and the consortium aimed to realize the best possible combination of learning arrangements in E-Mas, against the background of the pedagogical, technical, cultural, and economic requirements and conditions.

## 3 Approach for the Development of E-Mas

The approach of the Customer-Focused Blended Vocational Education and Training Development Navigator, in short CBVET-Development-Navigator, reflects the development approach, which was applied in developing the E-Mas further education program. This CBVET-Development-Navigator accompanies the process from an idea of educational services to its implementation in the target market, to maintain the competitiveness of the company and to master the barriers of internationalization of further education. The Navigator's customer orientation is characterized by the specific survey of the individual training needs of the customers, which are trendsetting for the conception of a training offer. This tool contains iterative feedback loops, especially in the conception phase, which enables the customer to give feedback on the current educational concept. Furthermore, it provides an approach to implementing a high-quality, profitable educational service. Besides, the CBVET Development Navigator serves as a planning tool for the development of educational services as well. It is characterized by its iterative and agile character: Although the three phases of the Navigator – analysis, conception, and implementation – have a clearly structured and deliberately chosen process sequence, they can be repeated as often as required. Figure 2 gives an overview of the CBVET-Development-Navigator.

Each of the three phases, analysis, conception, and implementation, consist of three iteration stages. With each higher iteration level, the steps of the respective phase become more concrete. This means that the individual steps become more specific and detailed as the process progresses. Within the iteration stages, no sequential procedure is provided. To achieve the phase-specific goals within these steps, selected methods are proposed. With the help of the respective method, the steps can be fulfilled in the best possible way. It is important that the methods also differ in their complexity and degree of detail. In lower iterations, the respective method takes up fewer resources and time than in higher iterations. The step e-learning takes on a separate role concerning the further steps. E-learning is covered in each of the three phases. In the first phase, e-learning is analyzed,

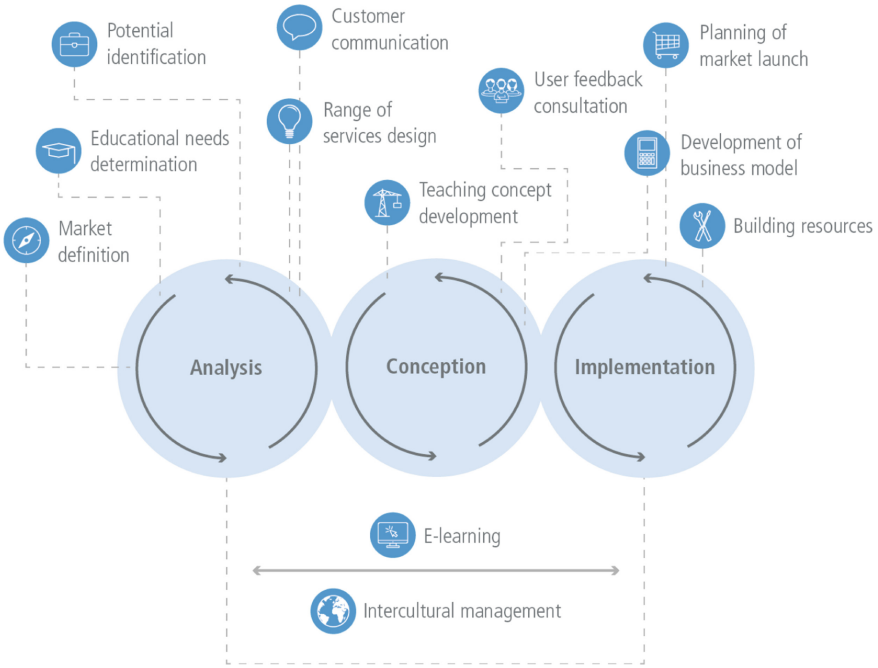


**Fig. 2.** Overview of the CBVET-development-navigator [own illustration]

defined in the conception phase, and finally implemented. Another special feature is the culture analysis, which is synchronized with all phases.

## 4 Work-Related Training Design

In most cases, a lasting competitive advantage is based on the knowledge available in a company. Even if markets change, new competitors enter the market or services and products reach the end of their life cycle, successful companies know how to defend their position because they can constantly generate new knowledge, make it available in a targeted manner within the organization and quickly transfer it into innovative services and products. A stronger work orientation or even the integration of learning into activities will be one of the central basic requirements for the success of Industry 4.0. In this context, previous qualification measures should be examined to see to what extent they meet the requirements of Industry 4.0 and how existing concepts can be made more work-oriented. In principle, 'learning at work' and 'learning far from work' can be distinguished as opposite poles. However, this does not mean a simple dichotomy. Rather, personnel development and qualification measures can exhibit numerous different degrees of 'work orientation', i. e. a pronounced proximity to the pole 'learning at work'. This work orientation can be further differentiated into 8 sub-dimensions, which reflect the classical elements of methodology and didactics from pedagogy. Highly work-oriented learning can therefore be described as 'learning close to work'. Figure 3 shows the model in overview.

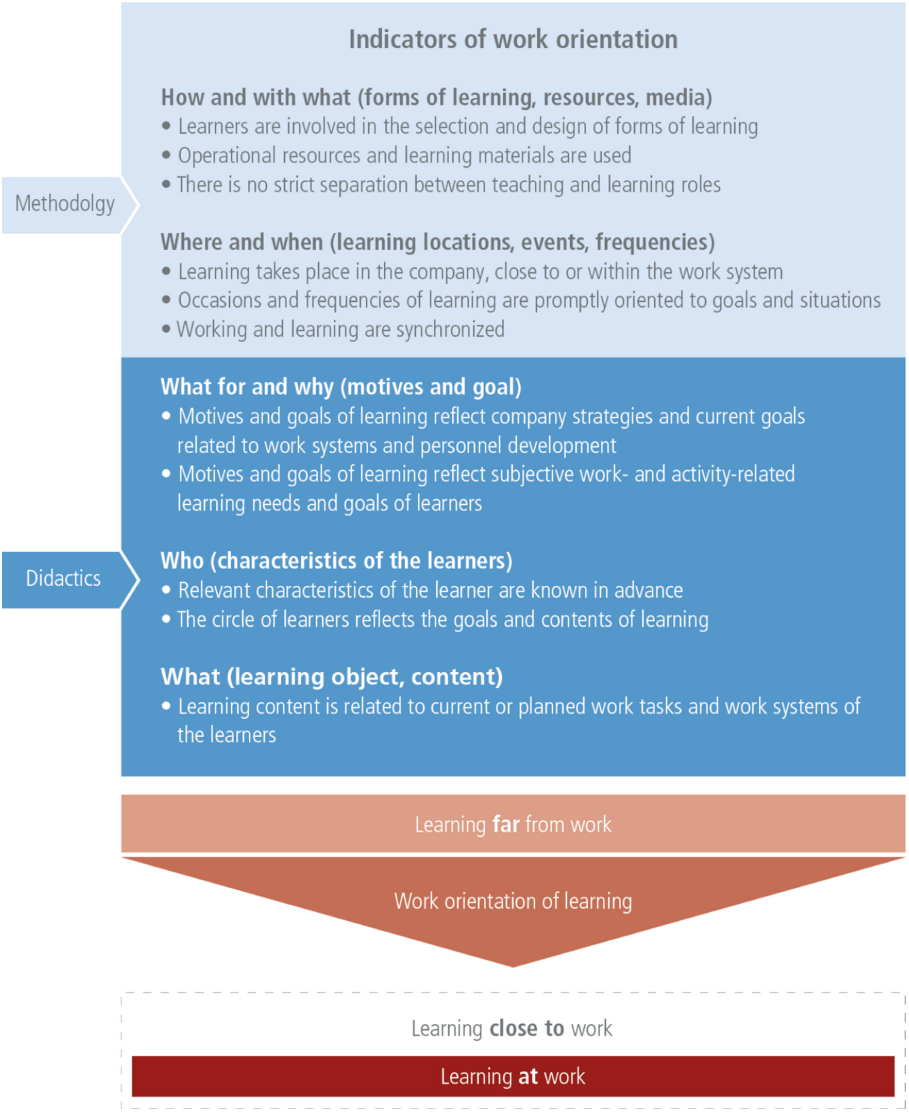


**Fig. 3.** Learning at work model (own illustration based on Mühlbradt et al. 2015)

First, it should be noted that the comments apply both to 'implicit' learning in the process of work and 'explicit' measures of personnel development and qualification in companies. As a side effect of work, implicit learning always takes place unsolicited. However, it cannot be assumed that learning at work always takes place to the necessary and desirable extent just because work is being done. If one understands the concept of learning facilitation as the sum of the conditions, '…which favor learning processes or create conditions favorable to learning when carrying out work in everyday working life' (Bigalk 2006, p. 38), then these conditions also include at least questions of task

design, management behavior, and access to relevant data and information from the work system. These further aspects are not dealt with here.

Digital learning as IT- and data-supported learning is increasingly coming into focus (Lutz Goertz 2014). The potentials of information and telecommunication technology, e. g. the internet, social media, tablet PCs, smartphones, data glasses, do indeed offer technical foundations for a wide range of learning forms and learning settings. However, it is rightly pointed out that this potential must be converted into functional and needs-based 'Learning Solutions' (Eichler et al. 2013, p. 6), the focus of which is not the technology but the benefit for the learner. Digital systems therefore only play an indirect role in the present context by helping to implement work-oriented learning solutions and to achieve desirable levels of certain indicators. Due to increasing customer requirements and more complex contractual terms and conditions, companies are faced with the challenge of constantly having to adapt and further develop the competences and skills of the responsible location managers and project managers in the area of order management. For this purpose, the existing qualification measures in the area of order management can be examined with the help of the analysis tool developed by FIR and MTM.

The following five dimensions were defined for the analysis tool: Learning content & learning objectives, organization, methodology & didactics, transfer, and sustainability. For each of these dimensions, different parameters were defined, which allow an evaluation of the degree of work orientation of qualification measures. In this context, various degrees of differentiation between the extreme points of a purely seminar-based qualification and a work-integrated qualification are possible. Figure 4 provides an overview of the analysis grid used.

Within the first dimension, it is necessary to question whether learning content and learning objectives are also geared to the actual needs of the respective company and whether these are also continuously surveyed. Also, content can be very abstract and general, or it can be tailored to the specific issues in the company.

The second dimension deals with organizational issues. For instance, a seminar-based qualification, the training courses of which are typically organized centrally by the company and the employees can hardly influence the selection process. Furthermore, neither clear personnel development goals are formulated, nor career planning takes place. The involvement of company experts such as those involved in the planning of work systems can obviously have an enormous impact on the extent to which learning processes can be integrated into the actual work. A further decisive point for the work orientation of qualification measures also manifests itself in the selection of instructors, because while internal instructors can refer to company-specific challenges, external instructors will tend to convey generic content. Finally, in the organizational dimension, it must be decided how the qualification measures are organized in terms of time and location. For instance, employees can be seconded for longer external training sessions, or the training content can be taught on-site as required in the work process.

The methodology & didactics dimension covers the design of the forms of learning in which the content is prepared. For instance, a seminar-based qualification is typically based on a textbook, while a work-integrated qualification is more likely to be based on case studies. The same applies to the design of tasks to be solved, as this can take

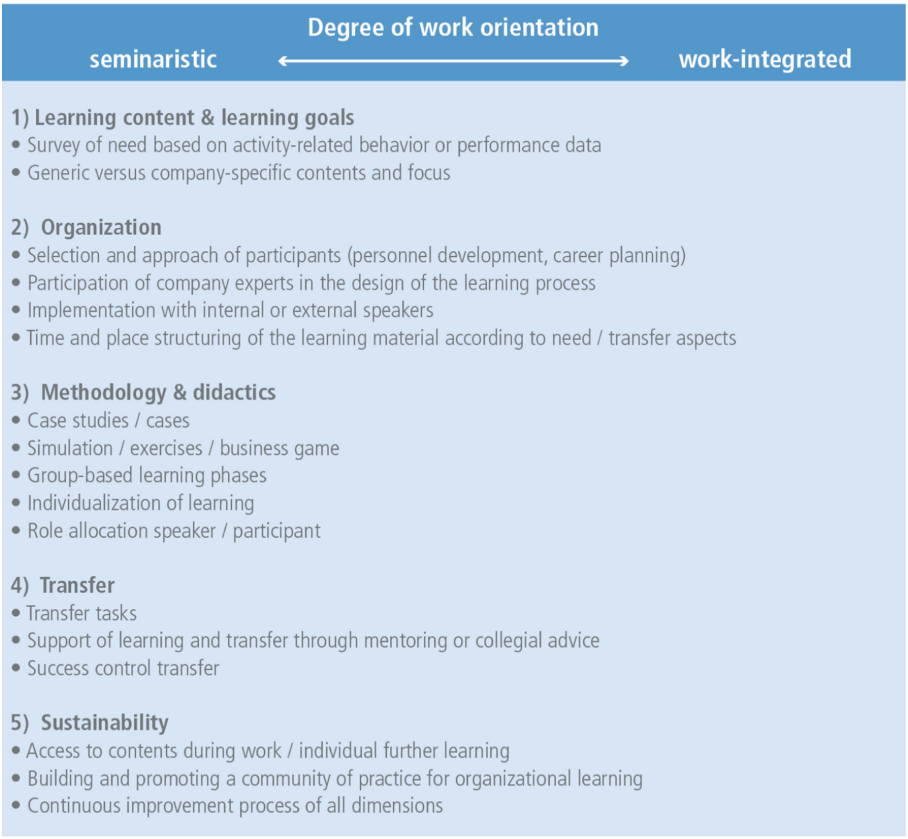


**Fig. 4.** Analysis tool to evaluate the work orientation of training (own illustration based on Senderek et al. 2014)

place in the form of classical exercises or be supported by business games and simulations. A further characteristic feature of a work-oriented methodology & didactics is group-oriented learning phases which, in contrast to classical frontal teaching, require the active participation of the participants. Furthermore, it is conceivable that learning content can also be tailored to the individual needs and abilities of the participants within corresponding learning groups. Finally, in the case of work-oriented qualification measures, the distribution of roles between instructor and participants can also be resolved, i.e. the participants themselves give lectures on their special fields and prepare parts of the lessons independently. Accordingly, the head of the training moves into the role of a moderator. The fourth dimension describes the transfer of imparted knowledge into practice. In this way, concrete transfer tasks can be directly linked to the qualification measure to achieve a stronger work orientation. Mentoring programs that go beyond the actual qualification measure can also support the transfer of what has been learned into practice.

The last but also central point of the dimension transfer is the control of success. Only continuous success control can ensure that what has been learned finds its way into practice or that obstacles are identified that need to be removed. The last dimension closely linked to transfer is the sustainability of qualification measures. Thus, a higher work orientation can be achieved if the content can be accessed during work and individual further learning is supported by additional content. Sustainability can also be significantly supported by building up a community of practice and thus individual learning processes can be combined into organizational learning. Finally, for the sustainability of qualification measures, it is important to ensure through continuous improvement that all the dimensions mentioned above are further developed and, if possible, are increasingly oriented towards work (Senderek et al. 2017).

## 5 Work Orientation of the E-Mas Program

To achieve a high work orientation, the E-Mas partners applied the analysis tool mentioned in the previous paragraph. Each of the four courses was designed along the five dimensions and evaluated along with the determined criteria. Thus, in the following the four E-Mas courses will be reflected accordingly. Generally, high applicability was intended for the Mexican automotive sector to ensure learning content preparing the participants for real practical work situations.

### 5.1 FIR Course 'Chief Workplace-Innovation Manager'

The certificate course 'Chief Workplace-Innovation Manager' of the Institute for Industrial Management at RWTH Aachen University provides participants with extensive expertise in the fields of competence development for the transformation towards Industry 4.0. Important topics that will be dealt with include the goals of transformation, the creation of working environments that promote learning, the integration of competence development and work processes as well as comparative management approaches for dealing with German and Mexican cultural differences. The target group consists of specialists and operative executives in the fields of work design, production management, and human resources management.

During the development of the course, intensive surveys in the form of personal interviews and questionnaires have been conducted to identify special needs. Furthermore, the content is less generic and far more highly company-specific, especially regarding company development. Thus, even a module about intercultural management was developed since this is an important challenge in German companies. Learning methods in the module 'Work design and competence development that promotes learning' were selected according to the specific needs of the Mexican automotive sector.

The participants were selected by companies and their respective HR/production departments and at the beginning of the course, a competence balancing by e-learning was carried out. Participants were motivated to use their company examples and to present real-life problems to develop real practical solutions. Moreover, courses were mostly planned as in-house courses.

The principles of the methodology and didactics of the course are reflected in case-based learning units. Apart from this, great importance is attached to the fact that face-to-face course units and e-learning units took place as group learning phases and group work. However, each participant, whether in group or single work, learned how to compile and learn for themselves during individual tasks.

Transfer tasks had to be defined at the end of the course to all three modules and were checked 3–6 months later. Also, supervisors were informed about the content acquired in the course to foster implementation and promote positive developments in their teams.

Before the implementation and during the execution of the course, the e-learning units were professionally accompanied. Most importantly, constant access to the learning materials was made possible through the e-learning platform. Furthermore, to ensure the flexibility and agility of the learning content, continuous adaptions and improvements to the course were made by including feedback and further developments of the content.

### 5.2 MTMA Course 'MTM-Practitioner'

The MTM ASSOCIATION offers courses to achieve the MTM-practitioner qualification. The MTM practitioner is the guarantor for MTM's compliance, accordingly, being the contact person for works councils, employees, and executives to design the MTM application in the company. Qualification as an MTM practitioner conveys knowledge and skills for the application of the MTM process, in particular the application of the individual MTM process module systems for the planning, design, and optimization of processes, work systems, and products. The target group consists of specialist and operational executives from the fields of industrial engineering, planning, time management, work preparation, production, logistics, occupational safety and health, product, and equipment construction as well as the works council and other interest groups.

Here too, intensive surveys were conducted. For this purpose, personal interviews and questionnaires were carried out to identify specific requirements. Special focus was laid on the training of the MTM experts in Mexico and the cooperation with MTM Mexico was important in this respect.

The participants for the course were selected by companies and their respective HR/production departments and the courses were mostly planned as inhouse courses or completely planned as e-learning courses. As real-life examples and problems in work situations are highly educational, participants were motivated to use and share their company examples.

The course is based on case-based learning units to ensure work orientation. Moreover, group learning phases and group work promote individual learning potential.

The support of learning and transfer through refreshment training after three years for MTM instructors has been proven to be successful. Furthermore, supervisors were informed about the content acquired in the course to foster implementation.

Printed MTMA learning material was handed over to each participant and constant adaptations to the course involving feedback were made.

### 5.3 WBA Course 'Expert Industrial Tool and Die Making'

The certificate course 'Expert Industrial Tool and Die Making' of the WBA Aachener Werkzeugbau Akademie, contains core elements of industrial tool making and conveys to the participants' concrete concepts and methods, with which traditionally more skilled tool-making companies can develop into industrial tool-making companies of international standard. Upon completion of the course, participants will be able to use current manufacturing technologies to optimize tooling processes, detect tool damage, and self-remediate. The target group consists of manufacturing professionals and operational leaders in toolmaking at Mexican automobile manufacturers and suppliers.

Before developing learning content, intensive surveys were conducted – personally and with questionnaires to identify special needs of the company. Moreover, the learning content was aimed at highly company-specific development, thus, even different formats were implemented to customers' needs. For instance, a one-week course and a three-week course were established and a stronger focus on repair and maintenance was offered.

Once more, the participants were selected by companies and their respective HR/production departments, and participants were motivated to introduce their company examples and present real-life problems they faced in everyday working situations. The courses were mostly planned as in-house courses or in facilities that enabled learning with machines and tools.

The structure of the course was based on case-based learning units. Furthermore, great importance was attached to face-to-face presence course units, and e-learning units took place as group learning phases and group work. However, individual tasks were not neglected, so that optimal learning results, whether in a group or single work assignments, were ensured.

The support of learning and transfer was made possible by performance reviews. On that, supervisors were informed about the content acquired in the course to foster implementation.

The sustainability of the content was ensured by accompanying webinars before the beginning and during the course. Adaptations to the course were included after obtaining feedback from the participants and companies. Moreover, permanent access was provided by media [tablets] during the course.

### 5.4 WBA Course 'Lean Management 4.0 Production Expert'

The certificate course 'Lean Management 4.0 Expert' of the WBA Aachener Werkzeugbau Akademie, imparts the participant's application-oriented knowledge and ability regarding the introduction and implementation of principles and methods of Lean Thinking for Industry 4.0. Lean Thinking is based on the five basic principles customer value, value stream, flow processes, pull principles, and perfection. In the course offered by the WBA, these principles are picked up and extended by the perspective of transformation according to a future-oriented and sustainable lean training. The target group consists of specialist and operational executives entrusted with the implementation of organizational change processes in the areas of production, administration, maintenance, and development.

To develop learning content and goals, intensive surveys were conducted. This took place in the form of personal interviews and a questionnaire to identify special needs. Lean experts of TEC de Monterrey/ITESM participated in the tailor-made course development.

The participants were selected by companies and their respective HR/production departments and in the beginning, the courses were mostly planned as in-house courses. Participants were encouraged and motivated to use their company examples and to present real-life problems to develop real practical solutions.

The methodology and didactics are characterized by interactive workshops, group learning phases, and group work and, to ensure a well-rounded learning result, an individual task that requested the application of the already learned content.

The participant's supervisors were informed about the content acquired and used the results of the success controls in the course to foster the implementation of the knowledge attained.

To ensure the flexibility and agility of the learning content, constant adaptions, and improvements to the course were made by including feedback into enhancements of the content. The focus from an all-over Lean perspective was adapted during the project to a stronger focus on Lean production.

## 6 Conclusion

In general, the work orientation of the E-Mas program has proven to be one of the key success factors for entering the Mexican automotive sector. Especially it was important to adapt the courses to the customers' topics and to integrate real-life cases into tasks and group works. The blended-learning concept supported the work orientation of the E-Mas courses since more general and basic content was taught by web-based-trainings, whereas webinars were used for content that requires more feedback. The training sessions, which required an even higher degree of interaction, were taught in presence. This also holds for training programs especially in the area of tool and die making in which machinery was required to perform training sessions on-site.

In addition, it became obvious that a constant and agile adaptation of content and methods was able to raise the satisfaction of the E-Mas programs' clients. The courses needed to be adapted to the requirements of the different clients and the mixture between web-based-training, webinars and presence learning had to be determined in cooperation with the respective client.

## References

Acatech [HRSG.]: Kompetenzentwicklungsstudie Industrie 4.0 - Erste Ergebnisse und Schlussfolgerungen. München (2016)

AMIA: Cifras de noviembre y acumulado 2019 [Press release] (2019). http://www.amia.com.mx/. Accessed 26 June 2020

Gundermann, A.: Mediendidaktik: Der DIE-Wissensbaustein für die Praxis (2015). https://www.die-bonn.de/wb/2015-mediendidaktik-01.pdf

Baumgartner, P.: Didaktische arrangements und lerninhalte - zum verhältnis von inhalt und didaktik im E-learning. In: Baumgartner, P., Reinmann, G. (eds.) Überwindung von Schranken durch E-Learning, pp. 149–176. StudienVerlag, Innsbruck-Wien-Bozen (2007)

Bigalk, D.: Lernförderlichkeit von Arbeitsplätzen-Spiegelbild der Organisation. Eine vergleichende Analyse von Unternehmen mit hoch und gering lernförderlichen Arbeitsplätzen. University Press, Kassel (2006)

Bundesinstitut für Berufsbildung [BIBB]: Staat und Wirtschaft in Mexiko vereinbaren gemeinsame Aktivitäten in der Berufsbildung (2017). https://www.bibb.de/de/5202.php. Access 21 Feb 2017

Bundesinstitut für Berufsbildung [BIBB]: Staat und Wirtschaft in Mexiko vereinbaren gemeinsame Aktivitäten in der Berufsbildung (2014). https://www.bibb.de/de/5202.php

Bundesministerium für Arbeit und Soziales [BMAS]: Weissbuch - Arbeit weiter denken: Arbeiten 4.0. Bundesministerium für Arbeit und Soziales, Berlin (2016a)

Bundesministerium für Arbeit und Soziales [BMAS]:. Weiterbildung im digitalen Wandel - Sammlung betrieblicher Gestaltungsbeispiele. Berlin (2016b)

CEDEFOP: European guidelines for validating non-formal and informal learning. Luxembourg (2015). http://dx.doi.org/10.2801/008370. Accessed 18 Sept 2022

De Witt, C., Czerwionka, T.: Mediendidaktik. W. Bertelsmann Verlag, Bielefeld (2007)

E-teaching.org: Blended Learning (2017). https://www.e-teaching.org/lehrszenarien/blended_learning. Accessed 27 Apr 2017

Eichler, S., Katzky, U., Kraemer, W., Michel, L., Stracke, C.: Vom E-learning zu learning solutions. Positionspapier AK Learning Solutions, BITKOM (2013)

Geissbauer, R., Schrauf, S., Berttram, P., Cheraghi, F.: Digital factories 2020: shaping the future of manufacturing, p. 48 (2017). Accessed 17 September

Gesellschaft für Internationale Zusammenarbeit [GIZ]: Mexiko (n.d.). https://www.giz.de/de/weltweit/306.html

INEGI-AMIA: Conociendo la Industria Automotriz [Press release] (2018). https://www.inegi.org.mx/contenidos/saladeprensa/boletines/2018/OtrTemEcon/CndoIndAuto.pdf. Accessed 26 June 2020

Kane, G.C., Phillips, A., Copulsky, J., Andrus, G.: The Technology Fallacy: People are the Real Key to Digital Transformation. MIT Press, Cambridge (2019)

Kerres, M.: Mediendidaktik: Konzeption und Entwicklung mediengestützter Lernangebote, 3rd edn. Walter de Gruyter, München (2012)

Kolb, D.: Experiential Learning: Experience as the Source of Learning and Development. Prentice Hall, Engle Wood Cliffs (1984)

König, P.: Bildung in Mexiko – Eine Momentaufnahme des Versagens (2013). http://www.firstlife.de/bildung_in_mexiko_eine_momentaufnahme_des_versagens/

Kramer, S.: Überzeugungsarbeit für mehr Fachkräfte (2016). http://www.tagesspiegel.de/wirtschaft/mexiko-importiert-duales-bildungssystem-ueberzeugungsarbeit-fuer-mehr-fachkraefte/13431946.html

Goertz, L.: Digitales Lernen adaptiv. Technische und didaktische Potenziale für die Weiterbildung der Zukunft (2014). https://www.bertelsmann-stiftung.de/de/publikationen/publikation/did/digitales-lernen-adaptiv. Accessed 25 Jan 2017

Mexico Business Publications: Mexico Automotive Review 2018, New Energy Connections LLC (2018)

Miller, C., Bartlett, J.: 'Digital fluency': towards young people's critical use of the internet. J. Inf. Lit. **6**(2), 35–55 (2012)

Mühlbradt, T., Senderek, R., Rodenhauser, T., Saupp, L.: Arbeitsorientierte Lernlösungen für industrielle Arbeitssysteme. Lernen für die Arbeit.(Reihe: MTM-Schriften Industrial Engineering, Bd. Ausg. 2). MTM-Inst, Stuttgart (2015)

Dummer, N.: Zwischen Drogenkriminalität und großer Zukunft - Die duale Ausbildung kommt nach Mexiko (2014). http://www.wiwo.de/politik/ausland/mexiko-die-duale-ausbildung-kommt-nach-mexiko/10950656-3.html

Paez Garza, R.A.: Leadership 4.0 and the digital transformation in the mexican automotive industry. Master in Science. RWTH Aachen University, Aachen, Germany (2020)

Riggio, R.E., Riggio, H.R., Salinas, C., Cole, E.J.: The role of social and emotional communication skills in leader emergence and effectiveness. Group Dyn. Theory Res. Pract. **7**(2), 83–103 (2003)

Roy, S.R.: Digital mastery: The skills needed for effective virtual leadership. Int. J. e-Collab. (IJeC) **8**(3), 56–66 (2012)

Senderek, R., Mühlbradt, T., Buschmeyer, A.: Engineering und mainstreaming lernförderlicher industrieller arbeitssysteme für die industrie 4.0. FIR an der RWTH. Aachen (2014). Accessed 1 July 2020

Senderek, R., Mühlbradt, T., Hempel, T.: Engineering und mainstreaming lernförderlicher industrieller arbeitssysteme für die Industrie 4.0. FIR-Edition Forschung (2017). Accessed 30 June 2020

Seufert, S., Schuchmann, D.: Zum Wandel der didaktischen Gestaltung "neuer" Lernformen. BWP@ Berufs-und Wirtschaftspädagogik, pp. 1–20 (2013)

Steinmeyer, F., Müller, A., Kersten, A., Schulte, S.: Marktstudie Mexiko für den Export beruflicher Aus-und Weiterbildung. iMOVE, Bonn (2012)

Volk, F.: Hasta la BMWista, Baby! Automobil Produktion, p. 67 (2016). https://www.automobil-produktion.de/abo/heftarchiv/ausgabendetail/heft/automobil-produktion-7-8-2016.html. Accessed 25 Apr 2020